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JARVIS, E.D.

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FIVE LECTURES
ON THE
SURGICAL ADJUSTER,
FOR
REDUCING DISLOCATIONS,
Adjusting Fractures,
AND
MAINTAINING COAPTATION.

INVENTED AND PATENTED

BY GEORGE O. JARVIS, M. D.

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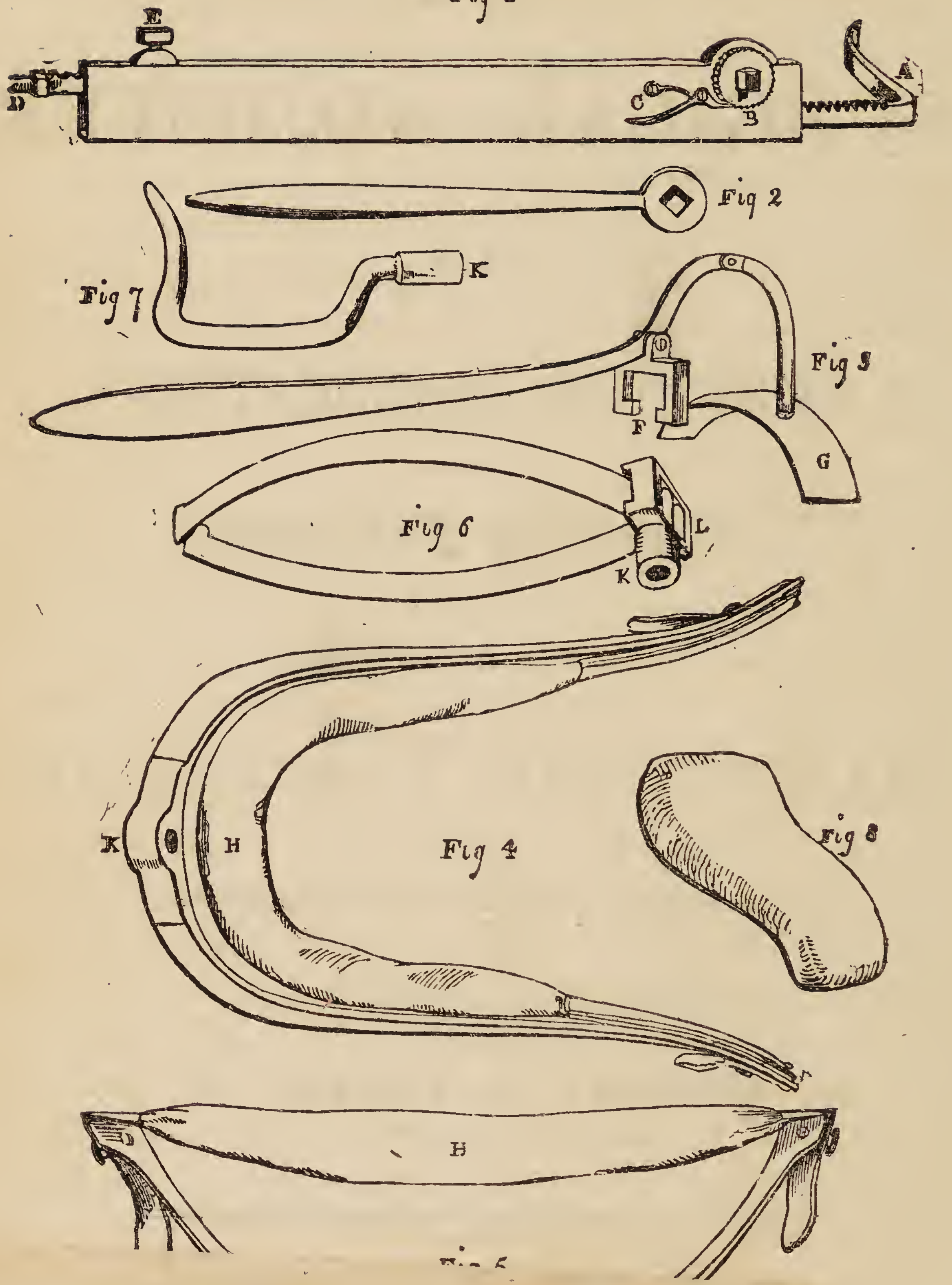


DESCRIPTION OF

JARVIS'S SURGICAL ADJUSTER.

A brass box or case (fig. 1) contains a rack-bar A, and a pinion-wheel within the case, the teeth of which match into those of the rack-bar, the pinion-wheel within being at one end of the brass case; the brass case is about thirteen inches long, and is divided in the centre lengthwise, so as to form two ways, one for the rack-bar, which is always the extending bar, and the other for the counter-extending bar, D, which may be drawn out and fastened by a small screw, E, at any desirable point. On the surface of the brass case, and on the same shaft with the pinion-wheel, is a ratchet-wheel, B, with a catch, C, corresponding to the teeth of the ratchet-wheel; the shaft of these wheels terminating in a square heel, to which the lever (fig. 2) is applied. On the end of the counter-extending bar, is received, according to the case to be treated, one of the four forks, the thigh fork (fig. 4), the shoulder fork (fig. 5), the jointed fork (fig. 6), or the elbow fork (fig. 7); these are each received on the end of the counter-extending bar by their sockets, K, K, K, K, and each in its turn, according to the case to be treated, is used as the counter-extending point of the instrument; while the end of the rack-bar, which is turned at a right angle with the part which is received into the case, is always the extending point of the instrument. There is also a side lever (fig. 3), which is used to apply force transversely to the line of extension, as in dislocations of the hip; the socket F is slipped on the end of the brass case at D, and when the thigh-fork (fig. 4) is received by its socket K on the end of the counter-extending bar, D, the plate G passes between the thigh-fork and the roll H, hanging loosely between the arms of the fork. To these belong several belts, straps and pads, which are for taking hold of the limb, securing the instrument, &c.

DIVISION OF THE MUSCLES OF THE THIGH INTO CLASSES—MECHANICAL ACTION OF THOSE MUSCLES IN FRACTURES OF THE BONE—USUAL VIOLATION OF THE LAWS OF MECHANICS IN THE TREATMENT OF SUCH FRACTURES—NECESSARY ATTENTION TO FIXED POINTS IN APPLYING FORCE TO REDUCE LUXATIONS.

LECTURE I.

The brief course of Lectures, of which the present forms the first, will contain a summary of my experience during twenty-six years of professional labour, the last five of which have been spent in a situation peculiarly favourable for the observation of fractures and dislocations, my attention having been particularly turned to the subject while designing, testing, and perfecting, the apparatus which is now offered to the notice of the profession for treating those injuries. Numerous opportunities have occurred to me for observation, at different hospitals in America, London, and Paris ; but it is not without feelings of due respect for the opinions and practices of others, for whom I entertain the highest regard, that I attempt to advance principles and to urge treatment which is at variance with those in common use. Still it appears to me that the cause of science demands the step to be taken. Therefore I comply with the kindly-expressed wish of those who have procured for me the opportunity of delivering these discourses under the present roof, trusting that the views which I advocate will be examined with care and candour, while I cheerfully say, that whatever I recommend that will not stand the test of experience on the part of others, let it be rejected. I have come to this country for the purpose of obtaining and communicating information in matters of surgery. During my sojourn in Europe, I have visited the whole of the hospitals in Paris, as well as those of London, and in the course of two months' attendance at the former, I have performed operations in some of the wards, which were planned wholly in accordance with the principles which I am now about to develop, happily with a success which had not attended the efforts previously made in the treatment of the injuries experienced. Having now completed the round of my observations in England, I am about to retire to my native country, the delivery of the present brief course being the only object which has induced me to defer, until another voyage of the Boston steamer, my departure from this metropolis, after having derived very great pleasure and advantage from my visit.

In calling your attention to that branch of our profession which is to form the subject of our present course, I do so under the firm conviction that much of the practice of the present day is characterized by a very unsettled mode of treating fractures and luxations, and is not consistent with the laws of mechanics ; or, in other words, that those laws are not so applied in practice as always to be made conformable with sound and well-settled principles in surgery. To show this, therefore, will be the object of the present lecture, after which it is my intention to illustrate the manner in which mechanical proceedings require to be conducted, in order to make them accord with those principles; and in doing so, I must once more express my obligations to the surgeon of this Hospital, Mr. Guthrie, and the committee of the Institution, for their generous permission to meet you assembled in this hall, before finally quitting this father-land for the western world which is my home.

I shall call your attention, first, to some of the effects which muscular contraction produces on a fractured bone as the result of the laws of mechanics; and, to save time, I will confine my remarks to fractures of the thigh, trusting that if these be well understood, their comprehension will be quite sufficient to enable us to apply those principles to practice in other fractures.

It will not, however, be thought necessary, I trust, that I should go into a particular anatomical description of the femur. You are already too well acquainted with the convexity of its shaft, its condyles, trochanters, oblique neck and round head, to need descriptions of them. But respecting the *myography* of the thigh, although you may be well acquainted with that also, still I beg you to allow me to call your attention particularly to those agents of mechanical action; because, on their attachments, their locality, and the direction of their fibres, depends the relative position which the two portions of a fractured bone occupy; and in order to make plain my views on this subject, let us divide the muscles of the thigh into three classes.

First, those which pass lengthwise over the femur, and yet are not attached to it at either extremity.

Secondly, those whose fibres are attached to it at one end, while the other is united to the pelvis above.

Thirdly those whose fibres are attached to the femur by one extremity, while the other descends, to be united to the tibia or fibula below.

I will call your attention to each particular class. Of the first, those which pass over the femur, are the rectus-femoris, the sartorius, the gracilis, the semi-tendinous, and the semi-membranous, the long head of the biceps, and the flexor cruris; and among these may also be classed, (from its mechanical action on the limb when broken) the tensor vaginæ femoris. These seven, when the bone is broken, only tend to shorten the limb by approximating the two extremities of the bone; and, in a fracture of the shaft of the bone, do not, in any measure, operate directly to throw the fractured portions out of a normal line. For such an effect as that we must look to other agents than the muscles just named, because it is a well-settled principle in surgery, not less than in physiology, that a muscle acts only in a right line between the points of its attachment.

Of the second class, or those having their attachments to the femur at one end and to the pelvis at the other, there are, the pyriformis, the superior and inferior gemellus, the internal and external obturators, the three glutei, (maximus, medius, and minimus,) the quadratus femoris, the three adductors, (brevis, longus, and magnus,) the psoas magnus, and the iliacus internus and pectineus. Of these, let it be remembered, all have their attachments to the femur at and above the point where the gluteus maximus is inserted, excepting the adductor longus, and about two thirds of the adductor magnus, the fibres of this last descending quite to the inner condyle.

Of the third class, or those diverging from the femur to the knee, there are the two vasti, externus and internus ; and between them, on the anterior surface of the bone, lies the crureus, while on its posterior surface are attached the two heads of the gastrocnemii, and the short head of the biceps flexor cruris. Of these, let it also be remembered, that they have the whole of their attachments to the femur, below the insertion of the gluteus maximus, excepting a portion of the two vasti, and a portion, also, of the crureus, whose fibres are attached to the entire length of the shaft of the bone. The fibres of these muscles diverge from the femur to the knee, as the fibres of the second class do from the femur to the pelvis.

We will now examine some of the effects which the mechanical action of this arrangement of muscles would be likely to have in fractures of the femur ; for, be it remembered, that the bone which before served as a connecting link for the action of all the muscles, (preserving, as it were, a just balance between them all,) now no longer serves as the centre of that harmonious action ; but a new centre, and a new combination of actions form around each broken portion, as the result of this lesion of bone.

We will now select a case by which to illustrate our views. We will suppose a fracture of the femur, between the trochanter-minor and the insertion of the gluteus maximus muscle, which, as you are well aware, would be in the upper third of the bone. Now what generally attracts our attention in a fracture at this point ? It is, the distorted figure of the limb, the peculiarly distinct angle at the point of injury, the unusual convexity at the upper and front part of the thigh. And why is this form peculiar to this injury ? excepting only those cases where the force applied to produce it has evidently interfered with the natural action of some of the muscles. Is it not from the balance of power on the side of the psoas-magnus, iliacus internus and pectineus muscles, all having their attachments, as we have seen, to the upper portion of bone, and also situated to act upon it anteriorly ? I ask is it not from the balance of power which these possess over those attached to the same portion posteriorly, which so casts the upper portion forward, while the fractured end of the lower portion is also carried forward with it from its attachments to the two vasti and crureus muscles, while the gluteus-maximus serves as a fulcrum to the lower portion in carrying the knee backwards, while the other extremity is thrown forwards by the attachments just named, and by the force which acts on the upper portion ? Here, then, arises the angle which we always see in fractures at this point ; here, too, the inclination of the lower always to separate from the upper portion or rising end of the bone, and it is only prevented to a much greater extent, as we may fairly presume, by its attachments anteriorly to the vasti and the crureus muscles. We also see, on the lower portion, a balance of muscular power on the posterior side, always inclining it backwards, as that on the upper always inclines that portion forwards, this arising obviously from the more favourable position which the two heads of the gastrocnemii and the short head of the biceps flexor cruris occupy for acting on this portion of bone than their antagonists, the two vasti and crureus muscles, now that its shaft is severed ; but more than this, that balance of muscular power must evidently be increased in both, as we depart from that angle of the limb which places the fractured portions nearest a normal line.

We here see, then, the mechanical effect which the muscles have on a fracture of the thigh at the point indicated. Let us next examine whether the laws of mechanics have not too often been violated or neglected in treating it ; and for the sake of brevity and clearness, I will first state that there are but two positions generally adopted by surgeons of the present day, in the treatment of fractures of the inferior extremities,—viz., the straight and bent position of the limb, the patient lying on his back. Nor are there but three distinct and leading methods adopted, at the present day, for the application of mechanical principles to this department of surgery ; yet there are a thousand ingenious contrivances through which these three are applied ; I refer to the double-inclined plane, to the straight splint of Desault, and to a combination of these two ; all others which I have seen are mere modifications of the one or the other of these, and do not, in any measure, escape the general principles on which their originals were based, so that as these are found to be right or wrong, so must the others be also—a particular description of them will not therefore be needed—indeed, our time will not allow it. And you will doubtless examine many of them, if you have not already done so, and decide for yourselves, whether I have correctly stated—and it is quite sufficient on the present occasion to call your attention to the fact. Let us now look at some of the effects which these different positions have on this fracture ; and for the sake of rendering both more clear, we will, at the same time, consider some of the mechanical effects of the three kinds of apparatus just alluded to. But with regard to position. It must be apparent, from what has already been shown, that to place the limb in a line with the body, inclines the fractured extremities asunder to the utmost limit which the vasti and crureus muscles will allow, from their attachments to the upper surface of the bone near the point of fracture—and much in proportion to the extent of lesion between the muscle and the bone will their tendency to separate be increased ; more especially as the muscular contractions are strong or weak in the limb, will the two fractured ends be drawn asunder. Any force, therefore, which can overcome this separation, must be more than equal to all the muscular contractions which produce it ; this force must be applied, too, exterior to the limb. Is it not plain, therefore, that we must apply force antero-posteriorly to overcome this separation of the fractured ends, which would be entirely uncalled for in a different position of the limb? Would it not require an amount, too, which is not always quietly to be borne? And more than this, should there be strong muscular contractions in the limb, what would be the effect of such an amount of force as to preserve co-aptation on the circulation of the limb, especially if this arose from an irritable system, with feeble constitution? Would it not also require a greater amount of extending and counter-extending force to restore the normal length of the bone, than if it were first placed so as to relax the flexor muscles of the limb? And would not the muscular tissue be more likely to be wounded and irritated by the fractured extremities, when the position is such as to render co-aptation difficult than in one where it is rendered comparatively easy? This is the position in which the straight splint of Desault is always to be applied, and in all its modified forms; and it is on account, mainly, of the extension and counter-extension to be obtained by it, that it is employed—a principle sound in theory, and important in practice, when correctly applied, but in this instance, by the very mode in which it is obtained, another one, of equal or greater importance, is entirely sacrificed—viz., that position which inclines the fractured portions nearest a normal line, and most effectually relaxes the muscles of the limb.

It is conceived to be a sound rule in this department of surgery, so to apply force as that the smallest amount capable of accomplishing the end shall be employed; it is believed the reasons for this are too plain and obvious to need comment.

We will, however, now consider the application of the double inclined plane, and here I will observe that apparatus seems to have been arranged more for the purpose of securing such a position as the surgeon shall choose than for any other object; and so far as position is concerned, it answers such intention quite well. Here we can not only relax the muscles which pass over the thigh, but we can also relax the gastrocnemii, and short head of the biceps; we can also so flex the limb on it, as to incline the lower portion of bone nearest a normal line with the upper, and can also approach nearest to co-aptation, of which the two portions are capable by the actions of the muscles. Still, unless the weight of the body is sufficient to answer all the purposes of extension and counter-extension, we shall fail to preserve co-aptation, although we may have once effected it. And here allow me to show the importance of extension and counter-extension in this position of the limb, not more for the purpose of co-aptation, than for relieving the tendency of the fractured extremities to separate. Allow me to fix your attention for a moment on the fibres of the crureus muscle attached the whole length of the upper surface of the bone, and also to the two vasti, attached in like manner, on each side of it. and these descending to the knee, to be united at the patella. What, I ask, would be the effect of traction, applied in the exact line of the limb, on the depressed end of the fracture, through the medium of these fibres of which we are speaking? Would it not be, to elevate the depressed portion to a line with the upper, and thus perfect co-aptation? Most certainly it would. Here, then, is where the double inclined plane, with all its modifications, is defective. But some may say, perhaps, there are many apparatus in use where extension and counter-extension may be applied with the double-inclined plane. I admit it ; but not so (pardon the assertion) as that the points of traction operate in the exact line of the shaft of the bone. And here lies the fault, as I humbly conceive, in the multitude of ingenious contrivances for treating fractures ; they all make the perinæum one point of traction, and the foot or the leg the other. It must be plain, therefore, to act on a limb laid on the double-inclined plane with any force from these points, that force is necessarily so applied as that more of it is spent at right angles with the bone than is exerted in the line of the limb operating favourably to produce extension and counter-extension ; and furthermore, all that is thus spent there, being sufficient to produce the necessary extension and counter-extension, tends to throw the fractured portions out of a normal line; and we have an amount, too, which, if rightly applied, would be altogether beyond the amount required for the object in view. And it is, moreover, applied in a manner which would not only be likely to give pain at the knee, but as the ligaments become elongated by continued extension, they would very likely deceive the surgeon in the length of the limb. But we will not extend our remarks on this point. We will next consider some of the effects of these laws on a fracture between the insertion of the gluteus maximus and the knee. And what do we observe in this that we did not in the other case? The chief difference which we notice is the greater mobility between the upper and lower portions of the thigh ; that peculiar angle and convexity of the thigh does not appear in this ; and although there may be a greater deformity in the limb, still that deformity is characterized by other marks of derangement ; as, for instance, the lower portion may appear as if thrown off from the upper, or if an angle appear, it may be either laterally or posteriorly; the inferior portion, however, being always found to lie at the back of the superior. And why do we find this difference in two fractures so near together and in the same bone? Is not the absence of an agent like that of the gluteus maximus in the lower portion, to serve as a fulcrum for those muscles which throw the fractured ends forwards, and the knee consequently backwards, the chief cause of this difference? To me this appears plainly to be the cause. In the first case, the fracture is more thickly covered with muscles than in this ; the muscles which attach to the fractured extremity of the lower portion, and are united to the pelvis, also depart from the bone nearer to a right angle than in this ; still these could not make the differences which we see, while the other might, and probably does, with reference to position. The same remarks which we applied to the first case apply to this also ; it cannot be necessary, therefore, to repeat them. Our remarks, too, in reference to the application of mechanical principles through the various apparatus, apply equally in this as in the other case ; nor will it be necessary to repeat them. We shall call your attention, however, to but one more form of fracture, and that, a fracture at the neck of the thigh-bone. And to avoid all physiological questions which might arise,—since it is only mechanical principles which are to be applied to surgery that I am attempting to discuss,—I will confine my remarks to a fracture out of the capsular ligament.

In a fracture at the neck of the bone, what do we observe? The limbs being at rest, and the patient on his back, the first thing which attracts the attention of the surgeon is, that one limb is shorter by some two or three inches than the one on the opposite side; the foot is also turned outwards, and perhaps the trochanter major may also appear somewhat prominent. These are the chief marks of difference which we notice on looking at the two limbs. And now, why so marked a difference between this and the other two cases? A greater difference in the fracture of any two limbs could not well appear; and it is the result merely of a lesion at this part of the bone rather than at another, which marks all the difference which we see. Is it not that by this fracture another and a different mechanical effect is allowed the muscles acting on the two portions of bone? May we not, therefore, expect that a different application of mechanical means would be required, in so marked a difference of the limb, to overcome this effect, and to restore it to its normal length and figure? Most certainly we may. In this instance the muscles of the first and second class only are concerned in producing the derangement in the line of the bone, the lower portions (which now includes the whole of the shaft and the trochanters) is thrown directly upwards, and the neck only is thrown from a normal line, and is also shortened, as one of the necessary effects of these mechanical laws, by the action of the muscles attached to the trochanter major and the pelvis. Now it must be manifest that we can more co-apt a fracture at the neck of the bone, without restoring it to its normal length, than we can one in the shaft without giving that its due length; and any apparatus which fails to do this, fails to fulfil all the indications which correct surgery requires in the case. I beg to call your attention, for a moment, to a particular arrangement between the pelvis and the head of the bone, for the purpose of calling your attention to it at another time, and that is, that the head of the bone serves as a pivot on which, at the pelvis, turns all the movements of the body with the lower limbs, even the smallest motion which is made between them gives motion at this point. Now, from what has already been shown, I presume I shall be anticipated in my remarks in reference to position, for it must be apparent that the straight position, or one nearly allied to it, must be the one which the mechanical effect, of which we have spoken, requires that the means for restoring the normal length and figure may be correctly applied to the limb; and here the straight splint of Desault would seem to be well adapted. But how would it be with the neck?—what in that apparatus is to restore that to its normal length? Unfortunately nothing; but on the contrary, much which is calculated to shorten it still more. We will endeavour to show this fact. One point of traction is to operate from the perinæum, by a band passed upward and outward on the anterior and posterior sides of the pelvis, to be made fast near the upper end of a broad splint, lying on the outside of the limb ; the other point of traction is to be at the foot, and is secured to the other end of the splint. Now, is it not plain, that just in proportion as we apply force to approximate the foot to the lower end of the splint, in order to lengthen the limb, that a portion of that force must operate at the top of the splint, to incline it towards the perinæum, that being the point of resistance from the body which connects it with the upper end of the splint, by means of the band, and which is out of the line of the two extreme points to which force is applied ? And therefore, must not the upper surface of the splint operate to depress the hip, just in proportion to the angle at which the belt is made to operate from the splint ? Hence, if we regard the length of the neck as of the least importance, or the wounding and irritating the muscles by the fractured extremities, this application of the splint cannot be right in surgery. Indeed, no one, under either arrangement which have been seen, tends to give length to the neck of the bone ; on this account they are all alike defective ; yet all do not actually depress the hip, but they may, and most of them do require a position unsuited to the condition of the limb ; and from two or more wrongs it is often difficult to make a selection. We will not, however, detain you longer on the subject of fractures, but will proceed to examine into some of the modes in which mechanical principles are applied for reducing luxations.

In these, the first and great object which we generally have in view, is to overcome any resistance which the muscles opposing reduction may offer to it ; that resistance is generally from the power which the muscles possess of approximating their points of attachment, when the head of the bone is dislodged from its articulating cavity. To overcome this resistance, extension and counter-extension have very generally and very necessarily been employed ; there have, however, been various expedients resorted to for accomplishing this end, only two of which remain in general use at the present day : these are, physical force, by the means of assistants, and mechanical, by the use of pulleys ; both alike are employed for the purpose of making traction on the luxated limb. I am aware that the screw has also been employed, and at various periods of the world ; but the objections to it are so grave and so numerous, that it has never been received into general favour ; I may therefore leave that out of the account. As it regards the two methods remaining in use, of their effect, mechanically, on the luxated limb, they are precisely the same ; for I cannot conceive a difference, where a given amount of force is employed, whether that force is applied through the pulleys, or through assistants, provided both are equally steady in their application, and the points of traction secured alike in both. What I would be understood to say is, that the mechanical operation of the two methods are alike on the luxated limb for all the purposes of reduction ; one may command more power, and the other may be more gentle in its operations, still on these points I can see no difference between them, both being, as they may be, of equal power, or one may be more steady in its operation, and the other more ready of application ; yet this does not affect the main principle, that both act mechanically alike on the limb, so that in discussing the principles of the one we also discuss those of the other. And what I would first call your attention to is, that they both operate from fixed points, over which the surgeon can have no control. Thus, if the line of extension happens to be the correct one, he does not desire it changed ; but if it happens to be incorrect, the force must first be relaxed before he can change it. It is the effect of being thus confined to these fixed points which I wish to consider.

We will suppose a luxated femur, the head of the bone in the iliac fossa. The appearances of the limb we will not stop to notice ; you are too familiar with them to render it necessary. One condition, however, which may exist, I beg leave to notice. In consequence of the oblique position which the head and neck occupy to the shaft of the bone, any force applied to the head from the other end of the shaft, and in a line with it, necessarily forces the head in some degree (while passing through muscle) to follow the obliquity of the neck, and not the line of the shaft, thus making an oblique track from the cotyloid cavity.

Suppose we apply the pulleys to reduce this luxated femur ; the head and neck being forced obliquely into the muscular tissue, as not unfrequently happens ; we have power constantly and steadily operating from fixed points, and before the direction of that force can be changed, we must relax it. Would not the head and neck, from their oblique position to the shaft, (and especially since the head is larger than the neck,) be likely to operate like a hook around a portion of muscle which lies directly below them ; and before they could be disengaged, (the force operating in one line) be likely to tear through the muscle or break the bone ? The case is not chimerical ; it has happened. But suppose, instead of the extending point being fixed, as in the case of the pulleys, it is left free, and subject to the command of the surgeon, while the force is steadily and constantly applied, would not the surgeon be much more likely to disengage the head by giving free motion to the limb, than he would by applying that force in one given line ? Here then, I conceive, is another error in the mode of applying mechanical principles to surgery.

I will detain you with but one more illustration. Suppose the case where the head of the bone is driven into the soft parts, and the neck is closely embraced by them,—as, for instance, in some cases of the head of the os humeri,—we must first disengage the head before we can even hope to succeed in reduction ; suppose, also, we apply the pulleys ; force is steadily and long continued, but owing to the firmness with which the neck is embraced, and the strength with which the muscles contract, it is not relieved from its confinement. Is it not plain, therefore, that should the extending point now be subject to the will of the surgeon to move at pleasure, while the force is yet constant and steady, to give free motion to the limb would greatly aid him in reduction, and that too without increasing the power? These are all grave questions, which it is the duty of every surgeon to answer satisfactorily in his own mind.

Thus I have endeavoured to point out clearly wherein the laws of mechanics are violated in this every-day business of the surgeon, and in doing so, I beg you to consider that it has not been with joy, but with sorrow, that I have attempted it; for these evils in practice pervade the entire civilized world, and I can only rejoice that, peradventure, I may be the humble means of supplying the remedy. It was the conviction within me of the existence of the evils of which we have been speaking, that first prompted me to make the attempt.

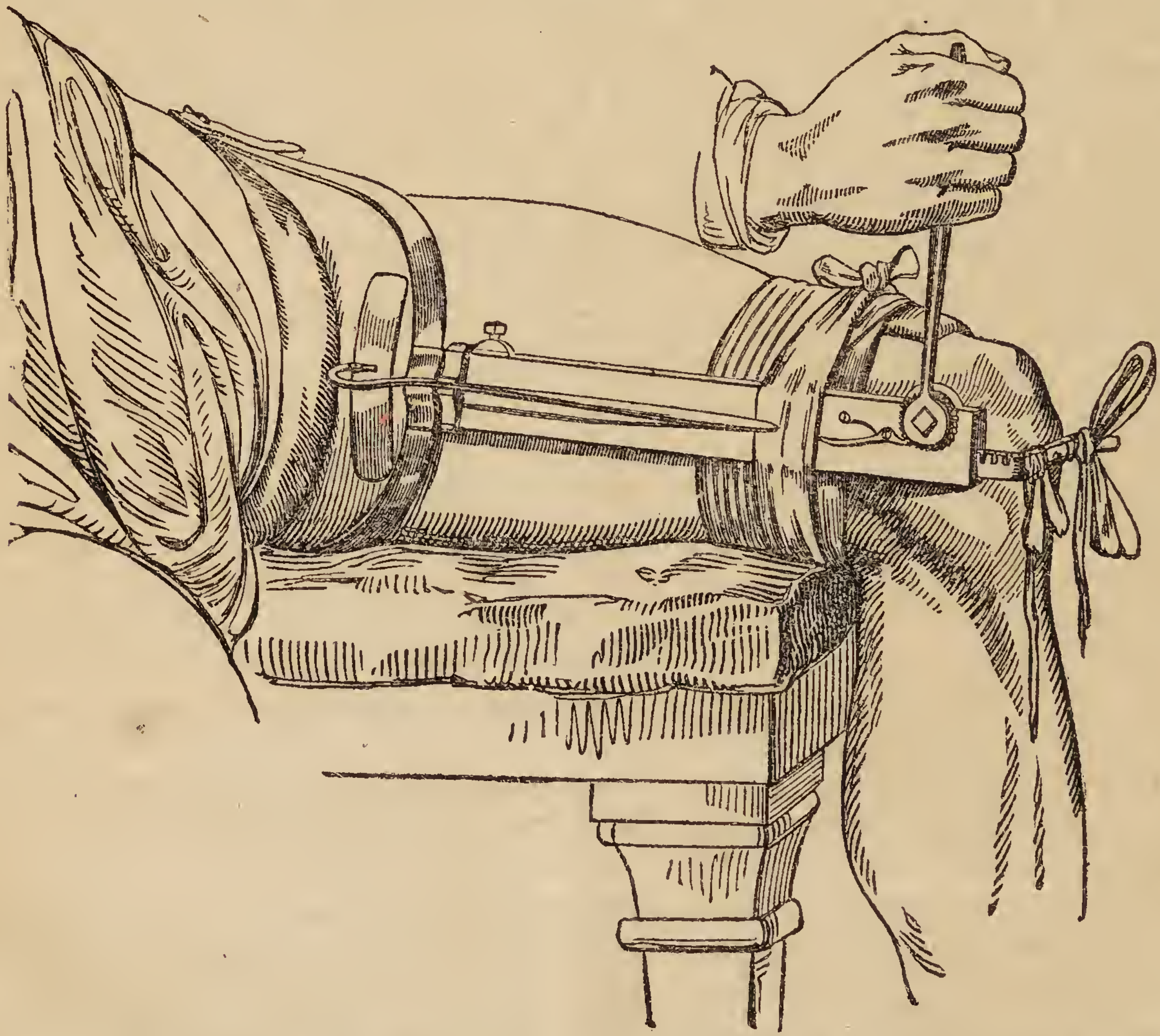
At our next meeting, I will call your attention to the mechanical arrangement of the instrument, and commence showing its application to the various luxations and fractures.

LECTURE II.

At our last lecture, we endeavoured to show wherein mechanical principles were often violated or neglected in attempting to apply them in the treatment of fractures and dislocations. It will be our endeavour now to show in what manner they are to be applied to be conformed to the principles of surgery in the treatment of these injuries. In showing this, I am to avail myself of the use of the instrument which I now show you; and that you may readily comprehend the various modes in which it is applied, and the manner in which it operates, allow me to explain its mechanical arrangement. But let me first, however, lay down the indications which it is intended to fulfil, which are—

1. To establish a line of extension between any two given points of the body.
2. To furnish an extending force which is unlimited in principle, yet easily calculated, and which is perfectly subject to the will of the operator.
3. To be able to combine with the simple extending force a lever of the first or second order, according to the exigency of the case, to act transversely to the line of extension, yet without in any way interfering with it, subject, in like manner, to the will of the operator.
4. To fulfil all these indications without in any way interfering with the mobility of the limb.
5. To enable the operator to apply the force, whether direct or transverse, either rapidly or slowly, and to retain it on the limb during his pleasure.

We will now apply it as to the four dislocations of the femur generally noticed by writers on luxations—viz., upward and outward on the dorsum of the ilium, backward into the ischiatic notch, forward and a little upward on the pubes, and under Poupart's ligament, and downwards and inwards into the foramen ovale; and if in all these positions of the limb we are able to apply the instrument so as to have any amount of power available which we require, and in whatever direction, too, that we need, and at the same time leave the limb just as free for motion as it was without the instrument attached to it, then do we not only have all the indications so far fulfilled, which are required of the instrument, but we also show in what manner mechanical force may be applied to a dislocated femur, without the extending point being fixed, as we found it to be at our last lecture, in using the pulleys, or with assistants, and against both of which we found weighty objections to lie. We will now apply it as to a dislocation upward and outward, the head of the bone resting on the dorsum ilii. We will first apply the belt around the thigh, immediately above the knee, with a loop lying on each side of the limb, and armed with strong cords; the instrument being arranged as before described, with the thigh-fork and side lever attached, and the roll suspended between the arms of the fork. We will now apply the instrument to the inside of the thigh, the roll pressing firmly against the perinæum, observing first to lay some soft substance between the roll and the skin, to prevent friction on the skin by the roll when we move the limb, such as wash-leather or cotton-flannel. Tie the cords closely around the foot of the rack, which have previously been passed through the loops, one arm of the fork having passed on each side of the pelvis, upward and outward to the top of the ilium; let a strap,



crossing the top of the ilium, pass around each arm of the fork, the strap having a buckle to it; let it make fast the arms in this position; and to press the instrument close to the inside of the thigh, let a thick bolster of cloth be laid under the strap crossing the ilium; tie a strap or handkerchief around the instrument and limb close to the knee; apply the lever and rack extension. Do you now wish to move the limb, to disengage the head of the bone from the gluteus minimus muscle into which it has been driven, while all of the power which you have applied is retained without the most trifling variation? you have the same liberty now to move the limb, which you possessed before the instrument was applied to it. Do you wish to throw the head of the bone from the dorsum of the ilium, while an assistant rotates the thigh on its own axis? the side lever is at your command, nor does it in the least affect the line of extension. Do you wish to apply force rapidly? describe one circle with the hand at the end of the lever, and you have near four inches of extension. Do you wish to relax all power instantly? apply your finger and press the catch which holds the ratchet-wheel, and quick as thought the force is gone. Do you wish to relax it slowly? with one hand take hold of the lever, with the thumb of the other raise the catch from the ratchet-wheel, and so long as the hand is obedient to the laws of voluntary motion, so long will the power be subject to the will of the surgeon. Thus we have any amount of power which we desire; it can be applied in the most gentle and steady manner, or with the rapidity of voluntary motion; it can be relaxed instantly or slowly, and retained during the pleasure of the surgeon; nor can the unruly movement of the patient in the least affect the line of extension, or change the relative position of the limb, while they are both entirely subject to the will of the surgeon.

We will now apply the instrument as in a dislocation into the ischiatic notch. The instrument is applied in every respect as before, except that the arms of the fork stand more backward, and the limb nearer to a right angle of the body, that the head of the bone may be drawn towards the acetabulum. Here we have occasion to use the side lever early, to lift the head of the bone from the sacro-sciatic notch as the extending force is applied to bring it forwards from that deep depression to the acetabulum. Here, too, we have the same power, the same liberty to move the limb during extension, the same facilities for applying or relaxing either rapidly or slowly, any amount of power which the surgeon shall choose to employ.

We will next apply the instrument as to a dislocation of the head of the bone on the os pubis under Poupart's ligament; and here we shall have occasion to use a lever of another order, that in which the body to be moved lies between the fulcrum and the moving power, while we shall also have the services of the same levers which we have already used if we require them. Now let it be observed, that the head of the bone is in its new position, out of the line of the upper third of the ilium. and the inside of the knee, some two or three inches; it lies above a transverse line passing through both acetabula about one inch. Let us apply the instrument in the same manner that we did before, only observing to place a bolster of cloth under the strap crossing the ilium, sufficiently thick to firmly press the instrument against the inside of the thigh. It may here be observed, that the greatest amount of force to reduce this dislocation is generally required to operate transversely to the body, yet, of force to restore the normal length of the limb much will doubtless be required. Now suppose, while we are applying the extending force, we also gently yet firmly, carry the instrument and limb outward. The instrument itself now becomes a lever; the strap passed around the arms of the fork, and crossing the dorsum of the ilium, now becomes the fulcrum; the head of the bone the body to be moved, and the surgeon gently applies his own force to the end of the lever as the moving power, while he at the same time can apply the lever, to the shaft of the pinion-wheel to make extension; and should he require the aid, also, of the side lever, he could add to that already applied five times the amount. It will be here observed, that the very mode of applying power transversely to incline the head of the bone to the acetabulum, depends on the freedom from that restraint which the pulleys uniformly impose. Thus have we sufficiently shown the application of the instrument of this dislocation.

We have but one more in which to call your attention in luxation of the hip, and that one when the head of the bone is lodged in the foramen ovale; and here we require an entire change in the application of power, and, of course, in the direction of the instrument. Here the head of the bone lies below the acetabulum, and, consequently, we require force in the line of the limb for no other purpose than to allow the head of the bone to pass over the cotyloid portion of the ischium; but here, too, allow me to observe, in all the cases which I have seen, the rectus femoris and the adductor muscles were remarkably tense; indeed, I can hardly conceive how it could be otherwise, there being no muscle whose direct tendency is to throw the head of the bone outward to its normal position; it is therefore plain, that the greatest amount of force is required in a direction transverse to the shaft of the bone, and this force must be applied on the inside of the thigh. It will readily be perceived, therefore, if we increase the tension of the adductor muscles,—it being transversely through those that we are to act on the head of the bone by the force applied,—that it will be with the greatest difficulty that the force reaches that head so as to be likely to move it from its present position, especially since it is often, in those cases, I doubt not, that the head is driven through muscular tissue in its passage to the foramen; and it is the firmness with which the neck is embraced by the tissues around it, when the injury becomes one of long standing, which frequently so resists our efforts at reduction; and to increase the tension of the adductor muscles by extension must increase the difficulty. To apply force, therefore, transversely, relaxing the rectus femoris and adductor muscles to the utmost limit which may be consistent with the condition of other muscles, and to move the limb freely, allow the head of the bone to glide over that portion of the ischium which separates it from the cotyloid cavity more readily than to apply force in an opposite direction, with all the advantages of moving the limb. We will therefore apply the instrument transversely; and in doing it, let me observe, that here the force is applied in the same manner that it is by the pulleys, when used for this luxation, as may readily be seen by consulting that excellent work on Practical Surgery, by Mr. Fergusson. Nor does the power here applied possess any advantages over the same power applied by the pulleys in the case under consideration, except that in this the power is not so likely to be disturbed by the unruly movements of the patient. Nor, indeed, is the force so liable to vary during the operation. In all other respects, then, as far as I have yet been able to discover, for reducing this luxation, they may be regarded alike; yet, in these respects, in a grave luxation, those advantages are many times of no small importance. In this dislocation, instead of using the thigh fork, we now remove it from the instrument, and apply the elbow-fork, (fig. 7,) by its socket, K, to the end, D, of the counter-extending bar. Apply a broad belt, or strap, with a buckle at one end, around the body, so as to make the ilium of the injured side the resisting point, the instrument lying flat and crossing the sacrum; let the broad belt be buckled round the fork, over the uninjured side, pass another strap round the upper part of the thigh of the injured limb, and under the broad strap at the groin; tie the strap passing round the thigh to the foot of the rack-bar; let both straps be tied to the instrument at the respective sides of the body; to prevent them from slipping from the instrument, let padding be laid between the instrument and the body, and between the straps and the body; now, by the lever we throw out the rack-bar, and consequently the head of the bone, while we are able to move the limb in any direction.

LECTURE III.

I am this evening to call your attention again to those principles of surgery which relate to fractures, particularly to fractures of the thigh. At our first lecture we endeavoured to show the manner in which the laws of mechanics were violated or neglected in treatment. It will be our object, this evening, to show in what manner they may be applied, so as to fulfil the indications required, or, in other words, to be conformed to the principles of surgery.

But before we proceed, allow me to lay down four principal rules, which I cannot but regard as essential in the treatment of all fractures. They are the following:—

1st.—So place the limb as that the fractured portions shall be inclined the nearest to a normal line of that bone, which can be effected by the action of those agents.

2nd.—So apply extension and counter-extension as that the smallest amount capable of preserving co-aptation shall be employed.

3rd.—So apply force as that the line of extension shall operate the nearest possible to a perfectly normal line of the fractured bone.

4th.—Let the points of extension and counter-extension be confined within the limits of the fractured bone..

If, in our treatment, we succeed in applying efficiently these four rules in practice, it is conceived that we then have the laws of mechanics conformed effectually to the principles of surgery, in the treatment of fractures ; if not, we fail in our object. We will first see, however, whether these rules have been correctly applied by the apparatus in general use. You recollect we showed that there were but three, although there may be, and undoubtedly were, a thousand modifications of these.

From what appeared at our first lecture, it is manifest, that in a fracture of the thigh, between the trochanter minor and the insertion of the gluteus-maximus muscle, and also, in one between the insertion of that muscle and the brace, and to place the limb in a line with the body, we violate our first rule by inclining the fractured extremities further from each other, instead of the reverse, as should be the case. And this is the position which the splint of Desault imposes. It also violates the second rule, by requiring more force to restore the normal length of the limb, than is required when the flexor muscles are relaxed. The third rule it appears not to violate. The fourth one, however, is violated, the points of extension &c. not being confined within the limits of the fractured bone.

We will now look at the double-inclined plane. In this it is obvious the first rule may be correctly applied—viz., that of inclining the fractured portions nearest a normal line, and relaxing the muscles of the limb. The second, third, and fourth rules, however, are altogether neglected.

We will also look at the double-inclined plane, so arranged as to produce extension and counter-extension, from the extreme points of the limb. The first rule, with this as with the last, would, of course, be correctly observed ; but how is it with the other three ? Of the second, our remarks at the first lecture pointed out that this rule would be violated by there being more force exerted at right angles with the bone than was employed in the line of the limb. Of the third rule,—is that any better applied ? In our remarks, we endeavoured to show, also, that the tendency of force applied to the extremities of a limb laid on a double-inclined plane, was to throw the fractured extremities out of a normal line. Hence, if our remarks on that point were, in any measure, correct, this rule is also violated. But let us look at the fourth rule : indeed, this one, too, is violated, the points of extension and counter-extension not being within the limits of the fractured bone. Thus, important as are each of these rules, (and it is believed their importance will not be denied by any surgeon,) yet we find but one of them applied by any one apparatus. I therefore ask once more—is not that apparatus defective, which applies but one of these rules in the treatment of fractures ?—which comes no nearer answering the intentions of the surgeon ?—which violates or neglects so important a rule in surgery as that of coaptation ?

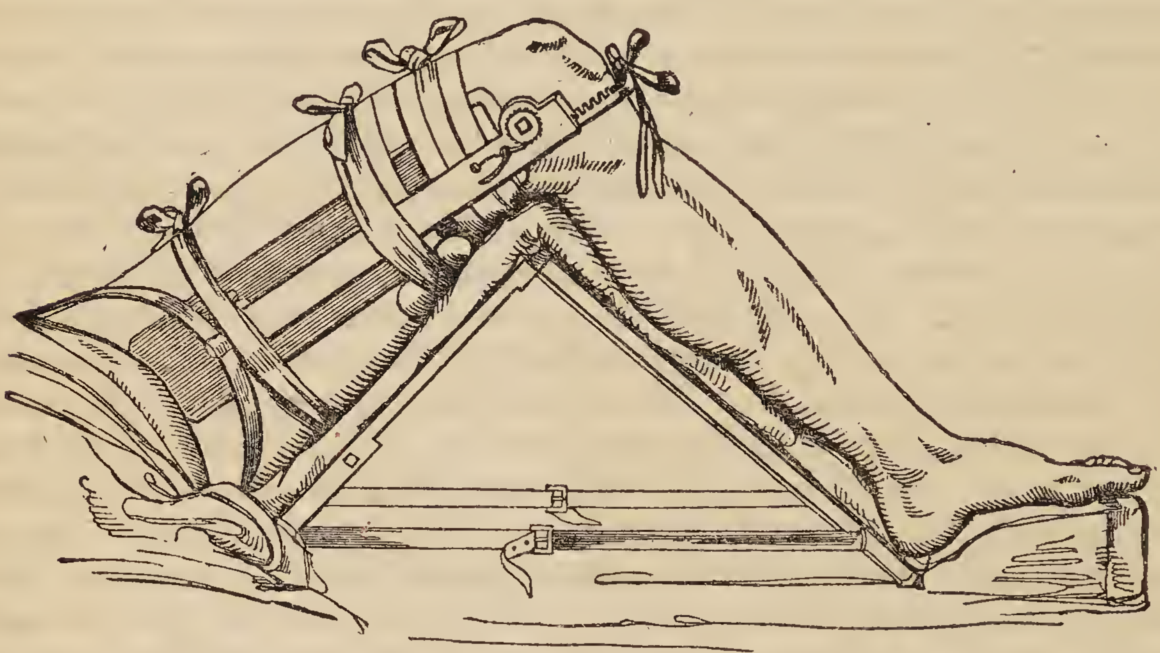
It will not be claimed, I trust, that I have here been making rules by which to try the various mechanical means. Those rules are true in nature, and are founded on the immutability of her laws, and hence were always true ; and the mere circumstance of my having given them a definite form for the purpose of aiding our own frail intellect, does not in the least touch the matter of their originality.

But some will say, perhaps, it is quite impossible to apply all these rules, and at once, in the treatment of any fracture.

During a recent visit to Paris, I was kindly invited by Marshall de Calvi, a military surgeon, and a gentleman of superior attainments in his profession, to visit the Val de Grace, a military hospital in Paris. At that visit he very kindly showed me through the various wards of that noble institution. He took especial pains to show me the fractures which were then in progress of treatment—for there were several, both of the leg and of the thigh, and in their various stages,—and what, think you, was my surprise, when I unexpectedly found, that precisely the same rules which I have here laid down as necessary to be observed in the treatment of fractures, were there correctly applied in practice : not, however, by adopting the same means which I employ, but those, nevertheless, which faithfully applied all those principles ; not so conveniently, nor so happily, perhaps, as might be desired, but yet they were applied ; and I had a good opportunity to judge, too, of their effects, as compared, not only with others, but also with those in my own practice. I understood they did not always, and in every case, employ the apparatus, probably from the inconveniences which attended its use, but when the least difficulty presented in preserving coaptation, they invariably resorted to it ; and the cases which I saw showed not only its efficiency, but the truth of the principles which I here advocate. Among all the hospitals which I have visited, I have not seen in one such good results ; they answered perfectly to the experience which I had had in applying those rules. I will not stop to describe the apparatus ; it was simple, and constructed on sound principles, but yet so inconvenient that it could not well be used except in hospital practice, and then not always with the facility desired. I was informed the name of the inventor, but unfortunately do not recollect it ; I was also informed that he ranked at the head of the military surgeons ; I regret having lost his name, the more from having had the honour of a very pleasant and agreeable interview with him. Whether the inventor of that apparatus designed to fulfil the same intentions which I had in view in the arrangement of the one which you saw, I know not ; all that I know about it is, that those rules were there applied, and I saw the results which I have already stated.

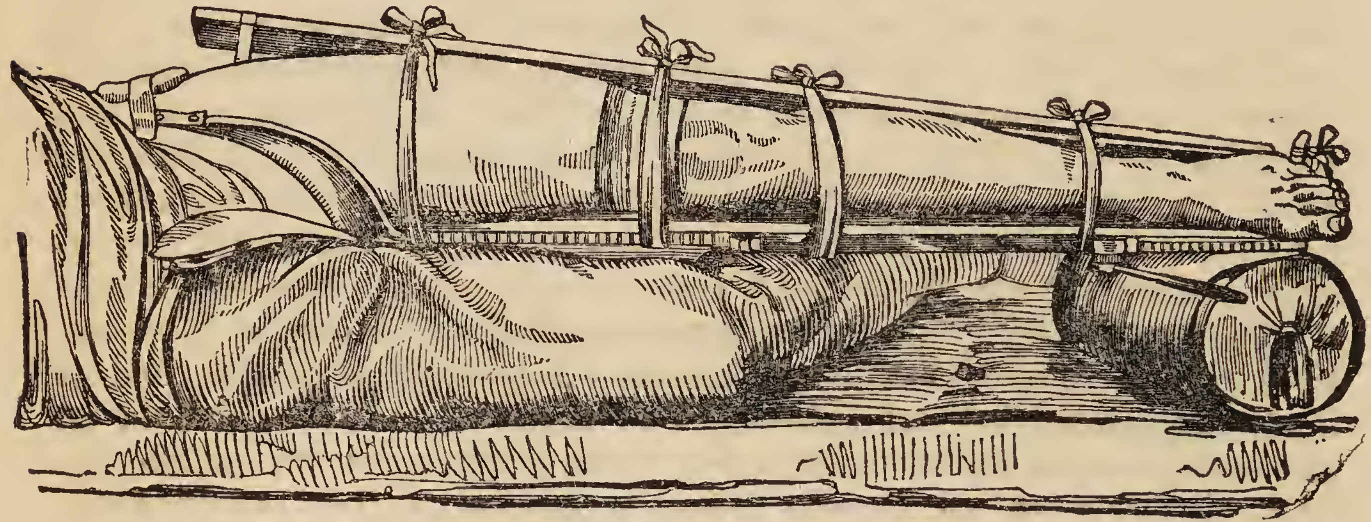
We will, however, apply the apparatus which you have seen here ; you will then be able to judge whether those rules may all be applied in fractures by this one. We will apply it as to a fracture of the thigh in the shaft of the bone.

We will first place the pads (fig. 8) one on each side above the knee, immediately back of the condyles; around the limb and pads first apply a common bandage loosely, to prevent the India-rubber surface of the belts from stimulating the skin; then apply a belt loosely, with a loop armed with tapes, on each side of the knee, the tapes crossing the bulbous part of the pad. Apply the instrument to the limb as in dislocation of the femur, except that the side lever is not attached to it; then lay the limb, and instrument attached, on the double-inclined plane, previously arranged with mats, or that which will make an easy surface on the plane on which the limb is to rest. Over the whole lay the eighteen-tailed bandage or tapes at suitable distances, ready for dressing after the bone is adjusted. All being arranged in the manner just described, the surgeon will with one hand apply the lever (fig. 2) to the shaft of the pinion wheel, while the other is laid over the seat of injury; thus with one hand he makes gradual extension, while with the other he is able to feel the progress which the bones make towards coaptation. When properly adjusted, apply splints on each side of the thigh, letting the ends pass a little distance under the pads; let the space between the inside splint and the instrument be filled up with folds of cloth, so that the pressure may be equal on the inside of the thigh. Apply the tapes or bandages over the whole. A bolster should also be laid under the bandage, between the instrument and plane, to support the former from bearing on the limb. I will also state here the mode which I saw adopted at the Val de Grace Hospital, from which to fix the point of counter-extension, and which, in some cases, I think I should prefer; the dextrin bandage was applied above, below, and over the knee, with tapes or a piece of roller inclosed in the coils of the bandage, so as to be tied to the counter-extending point of the apparatus; extension, could not, of course, be made by it, until the dextrin had become dry and hard. Those on whom I saw it applied appeared to wear it with perfect ease.



The same material was used for fixing the counter-extending point at the knee, and the extending point at the foot, in fractures of the leg. Thus, you now see the mode in which this instrument is applied on the double-inclined plane, and you will therefore readily perceive it is conformed to the first side, by the limb being placed on the inclined plane. It is also conformed to the second, by its being so applied as that the smallest amount of extension necessary to preserve coaptation is employed. It is conformed to the third, because the line of extension is the nearest possible to a perfectly normal line of the fractured bone. It is, finally, conformed to the fourth, the points of extension and counter-extension being confined within the limits of the fractured bone. Thus, we here see all the four rules applied to practice in this apparatus, and at one time.

We will now call your attention to a fracture at the neck of the thigh bone. But before we proceed, allow me to suggest another position in which that fracture may be treated; and for that purpose I will call your attention to that particular arrangement between the head of the bone and the pelvis, to which I alluded on the first evening's lecture—viz., that the head of the bone serves as a pivot on which turns all the movements of the body with the lower extremities. In this I wish to show you, that in a fracture at the neck of the femur, there will be less motion at the point of fracture, and between the fractured portions, by placing the patient on the side opposite the one injured, than there would be to place him on his back as is usually done. Our reasons for it are the following:—A person while lying on his back cannot raise his shoulders, or turn them to either side, even but a trifle, without producing motion at the fractured point; and how much inclined patients are to do this, you are doubtless all aware, especially for the purpose of viewing objects around them. Indeed, the movements of the head, and the trifle of corresponding motion of the shoulder, seems almost involuntary. Still involuntary as those motions may be, they all result in motion at the point of fracture; and it is not my wonder that so few fractures at neck of the bone result in an osseous union, but rather that there so many result in it; for motion, the great disturber of all osseous union, is constantly, yet involuntarily, employed by the patient. On the contrary, to place the patient on the uninjured side, the position subjects him to greater impediments to motion of the shoulders than on his back; he would be unlikely to raise his shoulders for any object, especially if he were told not to do so, yet his head he could move freely without communicating motion to the shoulders, his inclination to turn to either side would doubtless be increased, although that could be greatly restricted. Still, if the limb were properly secured with the pelvis, it would move with the body without producing motion at the site of fracture. These are our reasons for placing a patient with a fractured neck of the thigh bone on the side, yet if it is not found to answer (in the hands of others) equally well with those placed on the back, there is nothing in our principles or treatment in other respects which renders that position essential. We will however apply the instrument in the position we have been describing ; indeed, it is applied the same in both ; and it is only for the surgeon to select, according to the case to be treated ; the one of the sides being especially adapted to persons who are large and fleshy, and can with difficulty be confined on the back. We occasionally meet with such patients. I once had one, and I would have given anything to have been able to accommodate my patient with that position she so much desired, but it was before I knew how to accomplish it. Extensive sloughing, after everything we could do to prevent, was the consequence of her confinement ; and after suffering beyond my power of description, the case resulted in death. During the whole treatment, I was convinced, that could she be allowed to lie on her side—a position she had used for years—without at the same time provoking greater pain by the fractured ends of the bone piercing the muscular substance around them, she would have been comparatively easy ; but the last evil, at least for a time, seemed worse than the first. Her suffering was extreme, and she died at the end of about five weeks from the time of receiving the injury. But I will not detain you by stating any more cases. For the one, however, which I have have just related, should you ever have a case of the kind to treat, I doubt not you will feel greatly obliged for the account I have here given. We will now apply the instrument.

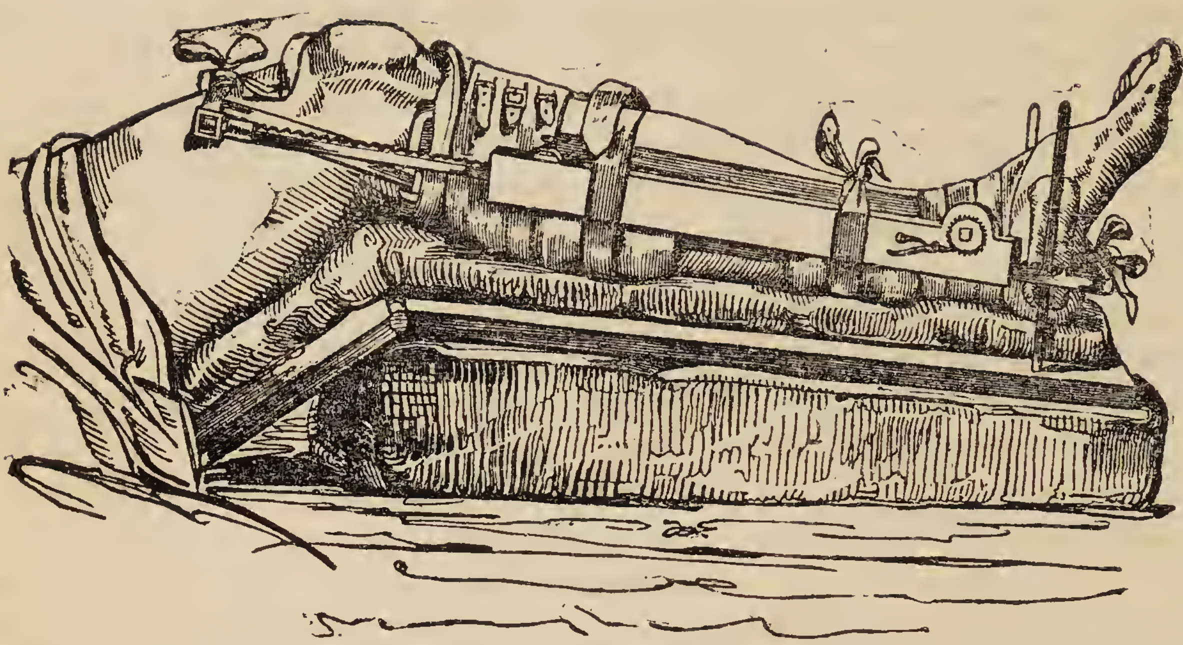


The surgeon should first be provided with two long splints, one to reach from the perinæum to the sole of the foot, the other from the top of the ilium to the sole of the foot, and with a square piece of cloth in which to roll the splints, so as to make a trough in which to lay the limb. First apply a belt around the thigh above the knee, minding first to protect the skin by a common roller. Let a piece of tape, of about three feet in length, be tied to each loop on the side of the knee ; now let the limb be laid between the splints, rolled in the cloth as described. The counter-extending bar, D, will now be drawn out to its full length, and made fast by the screw, E ; the thigh fork (fig. 4) will be applied to it with the roll, H, suspended between its arms, and the rack will be drawn out sufficient to allow the foot of it to cross the sole of the foot. Now apply the instrument on the external side of the inner splint, the roll, H, pressing against the perinæum as in fractures in the shaft of the bone. Draw the tapes tensely, and tie them on each side of the foot to the foot of the rack; apply the strap across the top of the ilium, and around the arms of the fork, in the manner before described; place a thick pad between it and the skin, and draw the strap sufficiently tense over it to give full length to the neck. Tie tapes around the whole at convenient points, to securely fix the limb, splints, and instrument, as one piece; the instrument may be further secured to the pelvis by passing a band once round the pelvis, and on its second turn, pass it round the end of the arm of its respective side, and make it fast to it—now give the necessary extension to the limb. I will not detain you to point out how the four rules have been complied with in the treatment of this fracture; I trust you will be able to discover it without my assistance.

LECTURE IV.

We will this evening endeavour to finish our remarks on fractures, and also on the dislocations of the inferior extremities. I will now call your attention to a fracture of the leg. But, before we proceed, allow me to remark, that we find the same anatomical arrangement for mechanical action—if I may be allowed the expression—in the muscles of the leg, which we found in the thigh; indeed, all of the long bones have the same general arrangement of muscles: we, however, cannot stop to classify them, nor, indeed, will it be necessary; your knowledge of anatomy will readily furnish you with this very natural division. First, of muscles passing over the bone, and yet are not attached to it at either end; second, those attached to it at one end, the other end being attached at some point above; and the third class, those attached, in like manner, at one end, while the other descends, and are attached below it. There are other muscles than those—for instance, where two bones lie parallel, as in the bones of the forearm, yet they do not materially affect this division, nor do they in the least interfere with the principles to illustrate which this division was made. It must be apparent, however, that much depends on this arrangement of muscles with the bone in placing it in a favourable position for coaptation; and by giving attention to this it will readily be seen what position the bone should occupy, when fractured, to preserve coaptation most readily. But we will proceed to apply the instrument as to a fracture of the leg. It is always to be applied in the same manner, let the surgeon adopt what position of the limb he may; for, be it remembered, with this instrument the surgeon applies extension and counter-extension independantly of position; position is one thing, and extension and counter-extension is another thing, and they should ever be left free and independant for the surgeon to apply at his pleasure; both are important principles in surgery; the one should, therefore, never be sacrificed for the other; and if right methods are adopted, it never becomes necessary.

Apply the bulbous part of the pads (fig. 8) one on each side of the leg, below the head of the tibia, and around them and the limb a belt with a



loop on each side of the leg, and standing upward over the bulbous part of the pad. Arm the two loops with tapes ; a belt may now also be applied to the ankle with tapes in it, but I much prefer a fracture-shoe instead of a belt round the ankle, (especially if there is any inflammation or swelling of the leg.) The double-inclined plane being arranged with a suitable mat, bandages, &c., and the instrument being properly arranged as to length, the arm of the jointed-fork, (fig. 6,) which will not be required for use, being removed from the fork, and the socket K of the fork being applied to the counter-extending bar D, let the tapes from the upper belt be tied to the arm, which remains in the fork, immediately above the knee, and the foot of the rack made fast at the sole of the foot ; lay the limb and instrument thus arranged on the double-inclined plane, make the necessary extension, and apply the dressing, minding to place between the instrument and the plane, and under the bandage, rolls of cloth sufficiently large to support the instrument against the middle of the leg ; proper splints should be applied on each side of the leg, and on the side at which the instrument is placed, the splint should be placed between the instrument and leg. I am inclined to think the dextrin bandage might be advantageously used with this instrument, in some cases, as a splint ; apply the bandage, with the limb nicely adjusted, and when dry, split the bandage lengthwise over the tibia, and cut away a piece about an inch wide through its whole length ; then, over the whole, apply tapes, at suitable distances. I have never used the dextrin in this form with the instrument, but its operation would be simple. I think I cannot be mistaken in the opinion I have formed of it ; indeed, I think it equally applicable in some fractures of the thigh ; of its use, however, in some of the cases in which I have seen it applied, especially the *manner* in which it was applied, I cannot too strongly deprecate. The leaving the limb enveloped for days in this unyielding casement, during the inflammatory stage of a fracture, is hazarding the limb of the patient and the reputation of the surgeon beyond all bounds of prudence. Nor, indeed, as far as I have seen, has there been less deformity in the limb resulting from its use ; yet there has undoubtedly been less trouble to the surgeon. And the practice of frequently cutting it off, and re-applying it, is necessarily attended with evils of the worst consequences ; for every time the dressing is re-applied, coaptation and the fractured ends must be greatly disturbed. When provisional callus has formed around the fractured ends of the bone, and yet the limb requires support, I have not the same objections to this use of the dextrin bandage. In such cases I think it highly useful when properly applied.

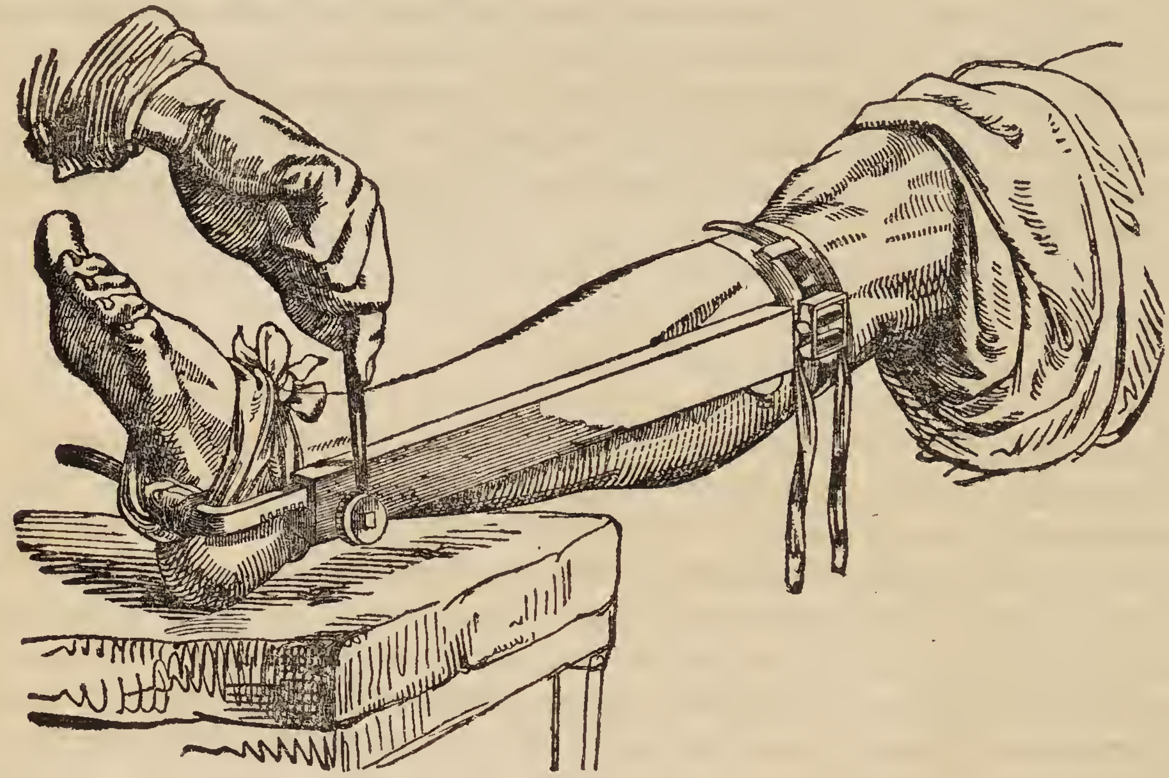
I will now call your attention to a fracture of the patella. It is not usual, however, that any mechanical means are required in this injury, other than to place the limb perfectly straight, and to elevate the foot so as to relax the rectus femoris and vasti muscles ; indeed any attempt to approximate the two fractured portions by an apparatus about the knee, generally results in a greater separation of the fractured portions, than to leave it as above described. Yet this is not always the case. There are instances in which it is desirable to overcome, in some measure, the extreme contractility of the three muscles above named. This may be done in the following manner :—Place the bulbous part of each pad against the fractured portions—one above, the other below, and around each and the limb apply a belt, with a loop lying over each bulb ; pass a tape through the loop, and tie moderately tight ; but through the upper loop pass a long tape, an end of which is to pass down on each side of the leg ; apply the instrument, as in fractures, at the neck of the thigh-bone, but without any splints or bandages ; let the ends of the tape be tied to the foot of the rack, crossing the sole of the foot, and on each side of it. Thus, by making extension with the instrument, the upper portion only is acted upon, and may thus be brought in contact with the lower, without applying the least force to it,—a point much to be desired, if we must needs have recourse to mechanical means.

We here close our remarks on fractures. We will now call your attention again to dislocations ; and particularly, this evening, to dislocations of the knee and ankle, beginning at the knee.

The knee is subject to luxations every way, though, fortunately, they are not frequent. When they do occur, the injury is apt to be so extensive, that amputation is required ; yet, in general, it is in those cases where reduction is most difficult, that the surgeon should, by all means in his power, endeavour to save the limb. It is not our business, however, to lecture either upon diagnosis or pathology,—ours merely relates to treatment. I will at once, therefore, explain how to reduce a luxation of the knee by this apparatus. There are two ways, and the surgeon is to select that one which applies to the kind of luxation which he has to reduce.

First method.—Let a belt be applied immediately above the knee, with a loop low over the patella ; another belt round the ankle, armed with strong cords, the instrument being arranged as in fractures of the leg : pass the arm of the jointed fork through the loop above named, and tie the foot of the rack, crossing the sole of the foot, to the lower belt ; make extension and free motion if necessary.

Second method.—Apply a large silk handkerchief, by a dove-hitch, immediately below the knee, the knot lying on the tibia in front; put the instrument on the limb as in fractures of the thigh, except that the foot of the instrument is to be securely fixed to the limb by the silk handkerchief: apply extension, motion, &c.



To reduce a dislocation of the ankle, buckle a belt round the leg, immediately below the knee, with one loop in front, on the tibia, and looking towards the foot; another one directly at the back of it, on the posterior side of the leg; pass the two arms of the jointed fork through the two loops above named, insert the end of the counter-extending bar, into the socket of the fork, and to make fast the extending point of the instrument to the foot, let the following method be adopted:—Let the back of the limb immediately above the heel rest on the middle of a large silk handkerchief in form of a roll, the foot of the rack lying across the hollow of the foot; bring the ends of the handkerchief down on each side of the heel, and cross them over the sole of the foot and foot of the rack; carry them forwards and cross them again on the top of the foot; pass each end, as respectively inclined, under the handkerchief, lying on the side of the heel; bring the end forward again to the top of the foot, and tie them closely and firmly down.

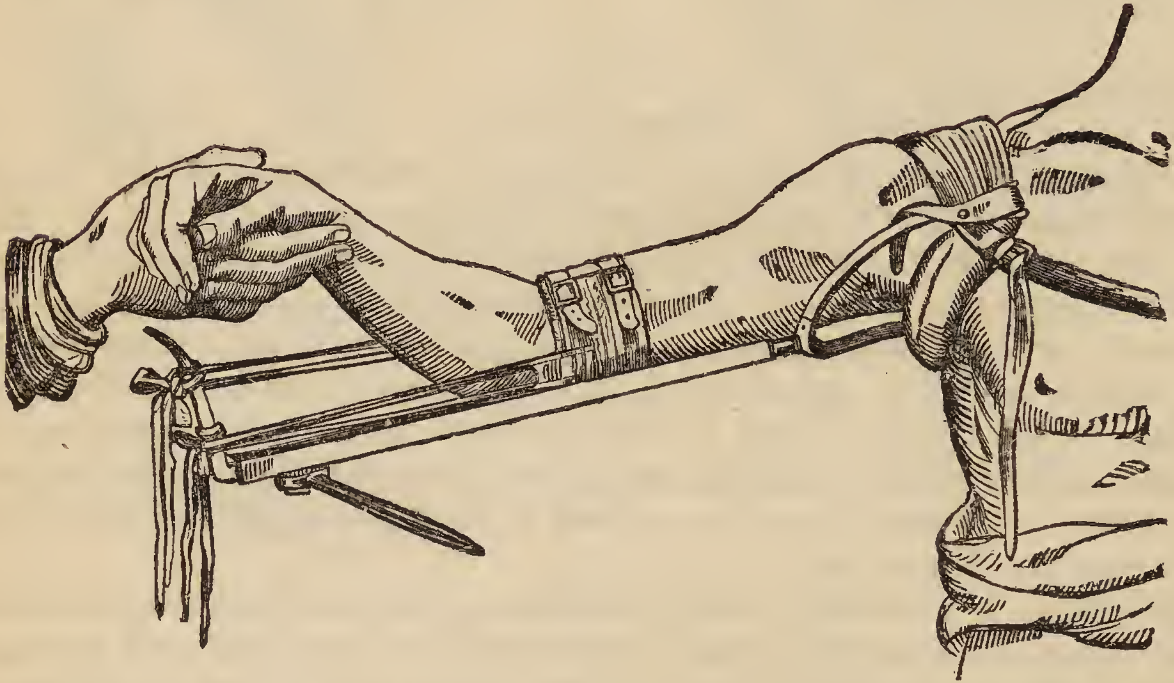
In a dislocation where the foot is thrown either outward or inward to a great extent, to prevent the sole of the foot from being drawn too suddenly under, another handkerchief may be thrown around the foot and tied to the foot of the rack, so as to prevent the foot from turning until the surgeon thinks he may have sufficiently extended the foot to admit the two points of the bones to pass each other, when he may suddenly loose the last-named handkerchief, when all the force will fall upon the handkerchief first applied, and the surgeon can manipulate the limb.

I conceive it quite possible, that in some cases an additional instrument might be required, to also make extension lengthwise of the foot in which case, or when the force is required between the tarsal and metatarsal bones, the jointed fork being attached to the instrument, and the instrument placed to the sole of the foot, let a strap pass from arm to arm of the fork in front of the leg, at the instep, and, with a band applied round the metatarsal bones, in the form of a dove-hitch, the knot lying on the under side of the first metatarsal bone, attach the foot to the foot of the rack. This is the mode in which I reduced a dislocation of the metatarsal from the tarsal bones, at Hôpital Cochin, as reported in the *Gazette des Hopitaux*, of October 2nd, 1845.

LECTURE V.

We will this evening call your attention to dislocations of the superior extremities. We will begin with those of the shoulder, and from the manner in which this instrument operates, you will at once perceive that it is not necessary that it should have but one mode of application for luxations of this joint, the line of extension being entirely under the control of the surgeon, to vary it at his will ; whether the head of the bone is under the tendon of the triceps, in the axilla, or under the pectoralis muscles, it is equally subject to his direction, and therefore is its one mode of application quite sufficient for every variety. We will now apply the instrument, and describe that mode.

Buckle a belt round the arm, immediately above the elbow, with one loop lying on the upper, and another on the under side of the arm. Through these loops pass strong tapes or cords ; and I think it well also, in grave luxation, to cover the whole hand and arm, below the belt, with a common roller, to prevent, in some measure, the congested state of the capillary vessels, which is always certain to attend the application of force, in whatever way applied from this point, and is frequently the cause of the greatest pain to the patient which they have to endure during reduction, especially where the operation must be long continued. Prepare the instrument, by buttoning tensely across the top of the shoulder fork (fig. 5) the roll H. Apply the fork to the counter extending bar D ; apply the roll in the axilla and tie the tapes closely round the foot of the rack. I would here recommend, in difficult cases, to lay in the axilla, between the roll and the skin, folds of cloth sufficiently thick to prevent the roll from pressing strongly on the tendons of the latissimus dorsi and pectoralis major muscles, the folded cloth being placed between those tendons. By doing this, the surgeon can, if he chooses, make the instrument operate precisely like the heel in the axilla, but much more steadily, and with much greater force than he can ordinarily command, and, moreover, the whole operation is immediately under his control. The instrument being thus applied, buckle the strap across the shoulder; or, which I prefer, pass the strap (which is used on the dorsum of the ilium in fractures at the neck of the thigh bone) around the roll on each side of the shoulder, crossing the top of the scapula, drawing the strap sufficiently tight to press the roll firmly against the under side of the shoulder, so that the line of extension shall be from the centre of the elbow to near the centre of the glenoid cavity. This being arranged, apply the hollow part of the strap (which accompanies each box of the instrument for that purpose) to the point of the acromion process, and carry the ends on each side, between the fork and the roll, and around the body; let it be drawn tight and buckled.



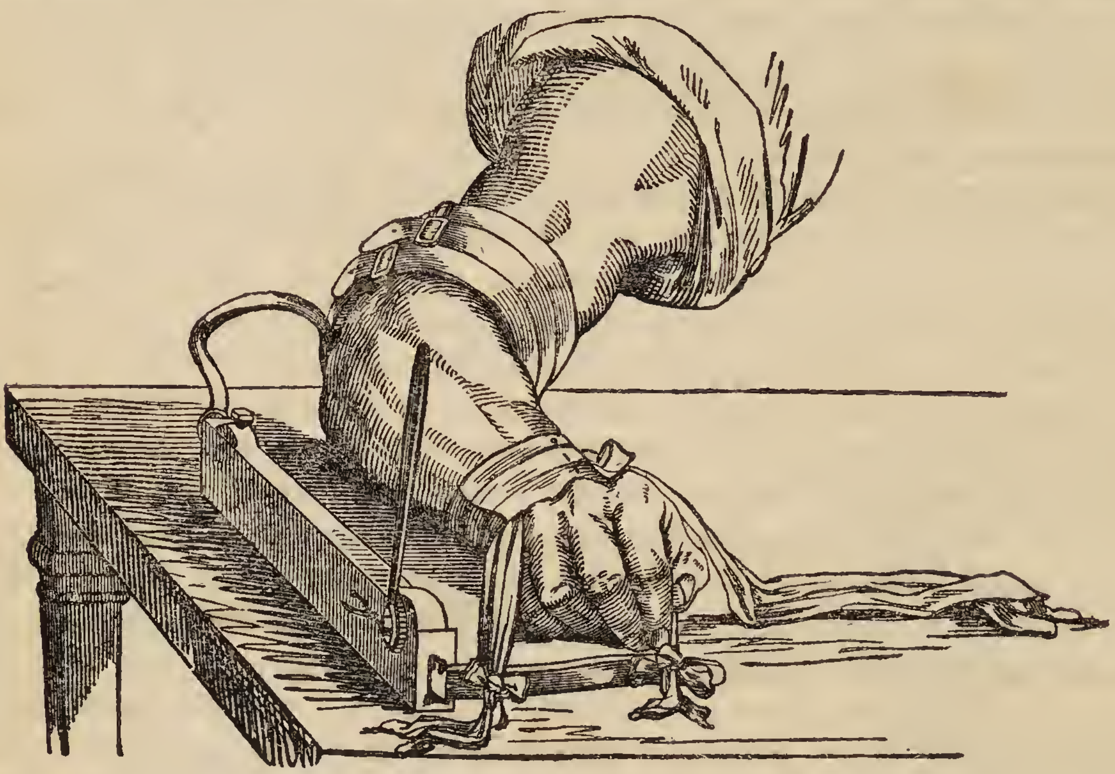
Thus, as you see, the instrument is now on the patient, and ready for the operation; and by the lever you hold great power in your hand, more than a prudent man would ever think to use on the shoulder. You will, however, soon get so accustomed to its use, that you will know very nearly the amount which you at any time use; indeed, by this instrument, with very little trouble, you may tell to an ounce the amount of power which you have applied. I will not detain you longer with this luxation, but will call your attention to one of the elbow. We will suppose the case, where the coronoid process of the ulna is lodged in the posterior fossæ of the humerus, and an important point in this dislocation, when it presents difficulties, is to be able to flex the arm while extension and counter-extension are operating on the limb, without any abatement of force. There are two ways of applying the force of this instrument in this luxation. Some surgeons have preferred the one, and some the other method. As for myself, I think them both important, according to the case to be treated; and if I had an exceedingly bad case, and one which required my best efforts to reduce, I should apply both modes at the same time, and which may be done very readily. I will show and describe them both; the first one described, however, is the one which I use.

Buckle the belt having a close or leathern loop on it around the arm, with the leathern loop low over the olecranon process, and the belt above it; buckle the second belt around the wrist, with a loop on each side of the hand, armed with strong tapes; insert the elbow-fork (Fig. 7) into the close or leathern loop, and the counter-extending bar, D, into the socket, K; tie the tapes in the belt around the wrist to the foot of the rack, minding to draw them closely round the foot of the instrument; with the lever make extension, &c.

Second mode.—Buckle a belt round the arm, below the shoulder, with a loop on the back, and another on the front part of the arm, the loops looking towards the elbow: pass the two arms of the jointed fork through the two loops, the joint being on the under side of the arm: on the fore-arm, and close to the elbow, apply a silk handkerchief, in form of a roll, by a dove-hitch, the knot resting on the ulna, immediately below the olecranon process; insert the end of the counter-extending bar into the socket of the fork and tie the handkerchief closely round the foot of the rack; to securely fix the instrument to the limb, let another handkerchief be passed closely round both, near the top of the instrument, and tied; with the lever make extension, &c. Thus you have the two methods explained, and you will readily see that they are both easy of application, and, at the same time, by employing two instruments. The last mode would bring the radius and ulna down, while the arm is in a flex position, thus drawing the coronoid process out from the fossa; the first would press the humerus backward, while the fore-arm was being flexed on the arm, thus bringing the coronoid process forward of the trochleated surface of the humerus.

We have but one more luxation to which we would call your attention, trusting that, if you understand those already shewn, you will be able to apply this instrument in every case which you may be called upon to reduce; that one is of the thumb; and although this is but a small member, it often makes a grave case for the surgeon, yet with this instrument I am quite sure you need never be defeated; and it is the same too with all the phalanges.

In showing the application of the instrument to reduce this luxation, it is not so easily exemplified as in the other cases in which you have seen it applied, mainly for the want of that peculiar prominence which the luxated bone presents, projecting over the side of the distal extremity of the bone from which it was dislocated, since it is around this prominence of the luxated bone that the force is to be applied. The thumb may be dislocated either backwards or forwards, and whichever way the bone is displaced, the force should be applied against the upper extremity of the distal bone. Suppose the thumb is displaced backwards—apply a broad tape, smoothly doubled, lengthwise, after having been met by a dove-hitch over the projected shoulder on the back of the thumb, letting the knot rest on the inside; apply the jointed fork to the instrument, and by the strap used to cross the dorsum of the illium, apply it in the form of a loop, hanging loosely down between the arms of the fork, being suspended from them; let the hand, between the thumb and the index finger, be made to rest against this strap, the back of the hand resting on this brass case ; then tie the tape which attached to the luxation to the foot of the rack, pass a handkerchief round the wrist and instrument, and tie it so as to confine



them together ; with the lever make extension, and as that is being made with one hand, with the other cast the luxated bone directly backward towards the wrist ; when the extremity of the bone to which the tape is applied has reached the edge of the articulating surface from which it was displaced, bring the luxated bone forward again, when the two articulating surfaces will readily be restored to their normal position, When the thumb is luxated inward, apply the tape to the prominent end on the inside—as it was before applied to that on the back of the thumb—and let the thumb be also cast inward, as it was before backward ; in all other respects the two operations are alike.

Thus we have now closed our remarks on luxations, and it only remains for me to return you my sincere thanks for the attention I have received while I have been attempting to contribute a small amount to the general stock of surgical knowledge. I can only say that my desire has been to do good, by endeavouring to improve the practice of that profession in which there should be felt one common interest ; and in conclusion, I have only to ask for what I have said, that it be judged by the standard of truth.

TESTIMONIALS.

14, *Saville Row*, *June* 13, 1845.

I have examined the machine invented by Dr. Jarvis for the reduction of dislocations and adjustment of fractures. The construction of it appears to me to be highly ingenious, and, as far as I can form an opinion on the subject, without having seen it actually employed on the living person, it is likely that it will prove very useful in severe cases in surgical practice. (Signed) B. C. BRODIE.

Woburn Place, *London*, *June* 14, 1845.

My dear Sir,—Your apparatus for the reduction of dislocations and the treatment of fractures, exhibits a great deal of mechanical ingenuity directed to the fulfilment of the indications in particular cases with superior efficacy. I consider the invention likely to prove exceedingly useful in old dislocations or displacements of the heads of bones, where the ordinary means fail, or cannot be employed with safety.

I am, my dear Sir, your's always truly, S. COOPER.

Dover Street, *June* 14, 1845.

My dear Sir, —I feel greatly obliged to you for the demonstrations which you have made of your instrument for reducing dislocations and adjusting fractures, and regret that I have not had an opportunity of trying its effects, so that I might give my testimony in its favor from actual experience. I have no hesitation however in stating my admiration of the apparatus, and that it appears to me, as the most ingenious and powerful ever devised for such cases.

I am, most faithfully, &c. W. FERGUSSON.

15, *Albermarle Street*, *August* 14, 1845.

Dear Sir,—I have examined carefully the apparatus which you have invented for reducing dislocations and adjusting fractures, and I have watched with great interest its application by you to these different objects. It appears to me, calculated to save much trouble to the surgeon and much pain to the patient, and, as a proof of my favourable opinion of it, I purpose to recommend one to be purchased for use in St. George's Hospital.

I am, dear Sir, your very faithful servant, ROBERT KEATE,
Sergt. Surgeon to the Queen, and Surgeon St. George's Hospital.

Keppel Street, *June* 20, 1845.

I have had an opportunity of examining the apparatus invented by Dr. G. O. Javis for assisting in the adjustment of fractures and the reduction of dislocations of the limbs, and I have seen the method of its application by its inventor. My belief is, that the apparatus is calculated to give increased power to the surgeon as well as precision in applying the power, at the same time, that it will enable him to dispense with several of the assistants, which are now required in some forms of the injuries referred to. For these reasons I regard the contrivance as an excellent one, and as well as can be judged without seeing it used in actual practice, I am satisfied that it will afford important assistance to the practitioner. It will readily be inferred, that, in my opinion, Dr. Javis is entitled to much credit for the persevering application of his ability and mechanical skill in the construction of so useful an instrument. R. QUAIN.

Brook Street, Grosvenor Square, June 16, 1845.

I beg to assure you that I have, with very great pleasure, witnessed the application of your apparatus for the reduction of dislocations. Many of the contrivances it presents appears to me entirely new, and they are certainly most ingenious. I can readily believe that your apparatus may be successful in the reduction of dislocations, when all other contrivances have failed, and, I am sure, the public in all countries owe you a debt of gratitude for the pains you have bestowed on so important an object.

Wishing you, most sincerely, the fullest success for your labours,
I remain, my dear Sir, your's very truly, EDWARD STANLEY.

Society for the Encouragement of Arts, &c.,
Adelphi, May 23, 1845.

Sir,—I have the pleasure to inform you that the Society have voted you their Gold Medal for your Surgical Adjuster, and that your card of admission is sent herewith.

I am, Sir, your's, &c., FRANCIS WISHAW, Secretary.

New York, December 4, 1843.

I am acquainted with Dr. Jarvis's "Surgical Adjuster." It is a valuable present from a highly deserving and intelligent Physician to the Surgical Profession. Its value to the surgeon cannot be too highly prized in the treatment of fractures and dislocations. It ought to be in the hands of every practitioner, and should make a part of the instruments in the possession of every surgeon in the army and navy. (Signed). VALENTINE MOTT.

Philadelphia, November 29, 1843.

I beg leave to offer my testimony in favour of an instrument of Dr, Jarvis's invention, for the reduction and treatment of dislocations and fractures. It is, unquestionably, a most ingenious and excellent apparatus, and must prove highly useful in many cases of accident for the relief of which it has been invented.

(Signed) THOMAS D. MUTTER, Prof. Sur., &c.

New York, November 4, 1843.

I have examined with much interest and satisfaction the apparatus calculated for all the purposes of extension and counter extension, invented by Dr. George O. Jarvis, of Connecticut. I am free to say, that as regards the reduction of dislocations, the adjustment of fractures, and the maintainance of coaptation of the latter, Dr. Jarvis has supplied a desideratum in this mechanical contrivance, and which in point of ingenuity and simplicity is perhaps unparalleled in the whole history of surgical instruments.

(Signed) SAMUEL FORREY,
Editor of the New York Medical Journal.